GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION
SPONSORED PROJECT INITIATION

Date: 9/5/80

Project Title: The Photochemistry of Tropospheric CO and NO_x and the Impact of Anthropogenic Emissions

Project No: ~~G-33-673~~ G 35-673

REISSUED TO CORRECT PROJECT NUMBER

Project Director: W. L. Chameides

Sponsor: NASA - Langley Research Center

Agreement Period: From 7/1/80 Until ~~6/30/81~~ 6/30/83

Type Agreement: Grant No. NAG-1-85

Amount: $59,728 (NASA)
1,358 (GIT: G-35-351)
$61,086 TOTAL

Reports Required: Semi-Annual Status Report; Final Technical Report

Sponsor Contact Person (s):

Technical Matters

H. D. Reichle, Jr.
Atmospheric Environmental
Science Division
NASA - Langley Research Center
Hampton, VA 23665
804/827-2576

Contractual Matters
(thru GCA)

Ms. A. S. Reed or Mr. C. L. Crowder, Jr.
Grants Administration
NASA - Langley Research Center
Hampton, VA 23665
804/827-2536

Defense Priority Rating: N/A

Assigned to: Geophysical Sciences (School/Laboratory)

COPIES TO:

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GEORGIA INSTITUTE OF TECHNOLOGY OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION/CLOSEOUT SHEET

Date 11/8/83

Project No. G-35-673 School/~~XXXX~~ Geo. Sci.

Includes Subproject No.(s) N/A'

Project Director(s) W.L. Chameides ~~XXXX~~ / GIT

Sponsor NASA; Langley Research Center

Title "The Photochemistry of Tropospheric CO and N~~O~~x and the Impact of Anthropogenic Emissions."

Effective Completion Date: 6/30/83 (Performance) 6/30/83 (Reports)

Grant/Contract Closeout Actions Remaining:

- [ ] None
- [ ] Final Invoice or Final Fiscal Report
- [ ] Closing Documents
- [X] Final Report of Inventions
- [X] Govt. Property Inventory & Related Certificate
- [ ] Classified Material Certificate
- [ ] Other _____

Continues Project No. _____ Continued by Project No. _____

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Form OCA 60:1028

G 35-672

GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL OF GEOPHYSICAL SCIENCES

Atlanta, Georgia 30332
(404) 894-3883

March 6, 1981

Dr. H. G. Reichle
NASA Langley Research Center
MS-401A
Hampton, VA 23665

Re: Six Month Progress Report for NAG-1-85

Dear Hank:

Our research program in tropospheric photochemical modelling is continuing at a rapid pace (thanks in no small way to NASA financial support via the subject grant). As you know from the preprints, I have recently forwarded to you during the past six months the following papers were completed with support from NAG-1-85:

1. Potential Role of CS_2 Photooxidation in Tropospheric Sulfur Chemistry, P. H. Wine, W. L. Chameides, and A. R. Ravishankara, Geophysical Research Letters, in press, 1981.

2. The Two-Dimensional Diagnostic Model for Tropospheric OH: An Uncertainty Analysis, W. L. Chameides, J. Geophys. Res., in press, 1981.

3. Hydroxyl Radical Measurements in the Marine Boundary Layer at Tropical and Sub-Tropical Latitudes: Comparison with Photochemical theory, D. D. Davis, W. L. Chameides, D. Philen, W. Heaps, A. Ravishankara, and M. Rodgers, J. Geophys. Res., submitted, 1981.

4. Rates of Fixation by Lightning of Carbon and Nitrogen in Possible Atmospheres, J. C. G. Walker and W. L. Chameides, Origins of Life, submitted, 1981.

In addition, I have presented five papers (three invited) at scientific meetings over the past six months. Funds from NAG-1-85 have also been used to support the work of Mr. S. McKeen, a Ph.D. candidate at Georgia Tech. Finally, my activities as an Associate Editor of JGR and GRL were indirectly supported by the subject grant.

I am looking forward to continuing our research program through the coming years and will be planning on receiving $65,700 on July 1, 1981 as budgeted for the second year of our three year grant. We are, of course, also anxiously awaiting the MAPS-shuttle flight, which will no doubt lead to some very exciting scientific investigations.

Sincerely yours,

William L. Chameides

WLC+ap

cc: R. J. McNeal

G 35-673

GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL OF GEOPHYSICAL SCIENCES

Atlanta, Georgia 30332
(404) 894-2857

September 25, 1981

Dr. H.G. Reichle
NASA Langley Research Center
MS-401A
Hampton, VA 23665

Re: Twelve Month Progress Report for NAG-1-85

Dear Hank:

I am writing this letter to bring you up to date on our progress over the past six months in tropospheric photochemical modelling as supported by NASA Grant NAG-1-85. Since our last progress report (March 6, 1981), two additional papers have been submitted for publication and two additional oral presentations at scientific meetings have been made.

A summary of our activities to date on NAG-1-85 is presented below:

I. Publications:

1. Potential Role of CS_2 Photooxidation in Tropospheric Sulfur Chemistry, P.H. Wine, W.L. Chameides, and A.V. Ravishankara, Geophysical Research Letters, 8, 543-546, 1981.

2. The Two-Dimensional Diagnostic Model for Tropospheric OH: An Uncertainty Analysis, W.L. Chameides, JGR, 86, 5209-5223, 1981.

3. Hydroxyl Radical Measurements in the Marine Boundary Layer at Tropical and Sub-Tropical Latitudes: Comparison with Photochemical Theory, D.D. Davis, W.L. Chameides, D. Philen, W. Heaps, A. Ravishankara, and M. Rodgers, JGR, Submitted, 1981.

4. Rates of Fixation by Lightning of Carbon and Nitrogen in Possible Atmospheres, J.C.G. Walker and W.L. Chameides, Origins of Life, ~~in press~~ 11, 291-302, 1981.

5. H_2O_2 Levels in Rainwater: An Indication of H_2O_2 Generation by Aqueous-Phase Chemical Reactions, R. Zika, E. Saltzman, W.L. Chameides, and D.D. Davis, Geo. Res. Letters, submitted, 1981.

5. H_2O_2 Levels in Rainwater Collected in South Florida and the Bahama Islands, R. Zika, E. Saltzman, W.L Chameides, and D.D. Davis, J. Geophys. Res., in press, 1982.

6. The Chemistry of the Troposphere, W.L. Chameides and D.D. Davis, Special Report in Chemical and Engineering News, submitted, 1981.

II. Seven oral papers (three invited) have been presented at scientific meetings.

III. My activities as an Associate Editor of JGR and GRL are partially supported by the NASA grant.

IV. Graduate students Mr. S. McKeen and Mr. S. Fischer are being supported by the grant.

Sincerely yours,

W.L. Chameides

cc: R.J. McNeal

GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL OF GEOPHYSICAL SCIENCES
Atlanta, Georgia 30332
(404) 894-2857

February 26, 1982

Dr. H. G. Reichle
NASA Langley Research Center
MS-401A
Hampton, Virginia 23665

Re: Eighteen Month Progress Report for NAG-1-85

Dear Hank:

I am writing this letter to update you on our progress in tropospheric-photochemical modelling research supported by NASA Grant NAG-1-85. We have recently completed a major effort in the area of gas-phase and aqueous-phase cloud chemistry; this research has resulted in the completion of a paper entitled "The Free Radical Chemistry of Cloud Droplets and Its Impact Upon the Composition of Rain" (JGR, in press, 1982). The paper presents the first quantitative study of free radicals in clouds and demonstrates that these species may play a major role in the chemistry of precipitation, in general, and acid rain, in particular.

A summary of our activities to date on NAG-1-85 is presented below:

1. Publications:

1. Potential Role of CS_2 Photooxidation in Tropospheric Sulfur Chemistry, P.H. Wine, W.L. Chameides, and A.V. Ravishankara, Geophysical Research Letters, 8, 543-546, 1981.

2. The Two-Dimensional Diagnostic Model for Tropospheric OH: An Uncertainty Analysis, W.L. Chameides and A. Tan, JGR, 86 5209-5223, 1981.

3. Hydroxyl Radical Measurements in the Marine Boundary Layer at Tropical and Sub-Tropical Latitudes: Comparison with Photochemical Theory, D. D. Davis, W. L. Chameides, D. Philen, W. Heaps, A. Ravishankara, and M. Rodgers, JGR, Submitted, 1981.

4. Rates of Fixation by Lightning of Carbon and Nitrogen in Possible Atmospheres, W. L. Chameides, J.C.G. Walker, Origin of Life, 11, 291-302, 1981.

5. H_2O_2 Levels in Rainwater collected in South Florida and the Bahama Islands, R. Zika, E. Saltzman, W. L. Chameides, and D. D. Davis, J. Geophys. Res, in Press, 1982.

6. The Chemistry of the Troposphere, W. L. Chameides and D. D. Davis, Special Report in Chemical and Engineering News, submitted, 1981.

7. Thunderstorms in Agriculture and in Forest Management, D. G. Decoursey, W. L. Chameides, J. McQuigg, M.H. Frere, and A. D. Nicks, in Thunderstorms: A Social, Scientific, and Technological Documentary, Ed. by E. Kessler, Vol. I, 85-112, Sept., 1981.

8. The Free Radical Chemistry of Cloud Droplets and Its Impact Upon the Composition of Rain, W.L. Chameides and D. D. Davis J. Geophys. Res., in press, 1982.

I. Nine oral papers (four invited) have been presented at Scientific meetings.

II. My activities as an Associate Editor of JGR and GRL are partially supported by the NASA grant.

IV. Graduate students Mr. S. McKeen and Mr. S. Fischer are being supported by the grant.

We will, of course, maintain our intensive research activities in this field in the coming years and thereby hope to continue to contribute to NASA's efforts in the area of Atmospheric Chemistry. I am currently planning on receiving $72,270 on July 1, 1982 as budgeted for the third year of our three year grant.

Sincerely yours,

W. L. Chameides

WLC:mh

cc: R. J. McNeal

Georgia Institute of Technology
A UNIT OF THE UNIVERSITY SYSTEM OF GEORGIA
ATLANTA, GEORGIA 30332

CHOOL OF GEOPHYSICAL SCIENCES

404/894-3893

uly 8, 1983

r. H.G. Reichle
ASA Langley Research Center
S-401A
ampton, Virginia 23665

Re: NAG-1-85
Final Report

ear Hank,

lease accept this letter as our Final Report on NASA Grant NAG-1-85 to Georgia ech for the period of 7/1/80 - 6/30/83.

efore beginning a discussion of our specific accomplishments over the granting eriod, I would like to note that on June 1, 1983 I had the honor of receiving he James B. MacElwane Award from the American Geophysical Union. I believe hat one very critical factor in making it possible for me to have received this ward was the continuing support I have received for my research from NASA over ne past seven years. I would therefore like to take this opportunity to express y gratitude to you and your colleagues at NASA Langley and in the Environmental bservations Division at NASA Headquarters for your interest in and support of y work in atmospheric chemistry.

s noted in NASA Conference Publication 2235 on Applying Modeling Results in esigning a Global Tropospheric Experiment, "...a more quantitative understanding s required of the ...chemical processes which influence the rate of removal of oluble trace gases throughout the troposphere." As a result the "development f models of combined homogeneous and heterogeneous processes" was proposed in his document as one important research activity to be pursued. In fact, one of he most significant advances we made during the granting period was probably in his area: the development of a model to simulate the gas-and aqueous-phase hemistry of a cloud. The strong coupling between gaseous and aqueous free radicals hat we have found to exist in a cloud gives rise to a variety of effects including he production of H_2O_2 and HCOOH. Not only can these processes have significant ffects upon the chemistry of precipitation and the removal of trace gases from the roposphere, but through "gas-to-particle-to-gas conversion" processes they can also epresent a significant source of gaseous species to the background atmosphere.

n addition to the above development we have completed the following investigations:

1. An in-depth study of the chemistry of tropospheric iodine
2. The development of a two-dimensional diagnostic model for tropospheric OH.
3. A proposal for a photodissociative sink for CS_2
4. A collaborative study with R. Zika of the University of Miami on $[H_2O_2]$ levels in rainwater.
5. An investigation of C and N fixation rates in a variety of possible primitive atmospheres.
6. A preliminary study of the possible sources of atmospheric formic acid.

uring the granting period the following publications have been completed:

1. Potential Role of CS_2 Photoxidation in Tropospheric Sulfur Chemistry, P.H. Wine, W.L. Chameides, and A.V. Ravishankara, Geophysical Research Letters, 8, 543-546, 1981.

2. The Two-Dimensional Diagnostic Model for Tropospheric OH: An Uncertainty Analysis, W.L. Chameides and A. Tan, J. Geophys. Res., 86, 5209-5223, 1981.

3. Rates of Fixation by Lightning of Carbon and Nitrogen in Possible Atmospheres, W.L. Chameides, J.C.G. Walker, Origin of Life, 11, 291-302, 1981.

4. H_2O_2 Levels in Rainwater collected in South Florida and the Bahama Islands, R. Zika, E. Saltsman, W.L. Chameides, and D.D. Davis, J. Geophys. Res., 87, 5015-5017, 1982.

5. The Chemistry of the Troposphere, W.L. Chameides and D.D. Davis, Special Report in Chemical and Engineering News, 60, 39-52, 1982.

6. Thunderstorms in Agriculture and in Forest Management, D.G. Decoursey, W.L. Chameides, J. McQuigg, M.H. Frere, and A.D. Nicks, in Thunderstorms: A Social, Scientific, and Technological Documentary, Ed. by E. Kessler, Vol, I, 85-112, Sept., 1981.

7. The Free Radical Chemistry of Cloud Droplets and Its Impact Upon the Composition of Rain, W.L. Chameides and D.D. Davis, J. Geophys. Res., 87, 5015-5017, 1982.

8. Increasing Atmospheric Methane: News and Views Article, Nature, 301, 568, 1983

9. The coupled gas-phase/aqueous-phase free-radical chemistry of a cloud, (with D.D. Davis) Proceedings of the 4th International Conference on Precipitation Scavenging, Dry Deposition and Resuspension (SCADER), edited by G. Slinn, in press, 1982.

10. Aqueous-Phase Source of Formic Acid in Clouds, W.L. Chameides, D.D. Davis, Nature, in press, 1983.

hirteen oral papers (five invited) have been presented at Scientific meetings.

y activities as an Associate Editor of JGR and GRL are partially supported by the ASA grant.

raduate students supported by the grant include: D. Bai and K. Levitan. S. McKeen as supported in part by NAG-1-85 and will be completing his thesis by September, 1983.

hank you again for your continued interest in my research activities.

incerely,

illiam L. Chameides

c: C.L. Crowder
R.J. McNeal
LC/abg